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# SPATIO-TEMPORAL ANALYSIS OF AGRICULTURAL DEVELOPMENT A BLOCK-WISE STUDY OF DEHRADUN DISTRICT

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## ABSTRACT

*In the present paper an attempt has been made to find out the spatio-temporal variation in the adaptation of improved agricultural practices to ascertain the level of agricultural development in Dehradun district of Uttarnchal. The study is based on the block-wise published data obtained from Statistical Bulletin of Dehradun district. The spatio-temporal pattern of agricultural development is determined with the help of thirteen variables. Beside this, the analyses have been carried out by transforming and combining the data related to thirteen variables, using 'Z' score to get the composite score. On the basis of Composite Score, developments of blocks have been categorized into three categories i.e. high, medium and low. Results of the aforesaid analysis shows that the modern technological inputs have reciprocal relationship with agricultural development in the study area.*

**Keywords:** Cropping intensity, Irrigation intensity, Agricultural workers, Development blocks and Agricultural development.

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## INTRODUCTION

Agriculture is the main source of livelihood for millions of people in India. Agricultural development is central to all strategies of planned socio-economic development in India. Spectacular break- through in agricultural research, technology development and dissemination under the umbrella of Green Revolution has been major factors in increasing both agricultural production and productivity. The socio-economic factors, the regional institutional setup and the natural factors varying over geographical area together provide a climate for a particular nature of agricultural development framework. Agricultural development enhances social and cultural development due to an increase in per capita income. There is an overall improvement in the quality of life which gets expression in the level of education, health care, better housing and so

on. Cultivators are able to make use of technology and go for the improved method of farming. The first important work on problems and prospects of agricultural development in India is the Report of the Royal Commisssion on Agriculture in India (1928) which provides an authentic report on many problems that were responsible for agriculture backwardness in India, suggestions for improvement of agricultural situation have also been given. Banerjee (1969) suggested that the future of Indian agriculture depends on the adoption of adequate strategy in agricultural planning based on comprehensive assessment in agricultural resources potentiality in social and economic infrastructure and their possible impact on the country as a whole. Kanwar (1970) has focused attention on the modernization of Indian agriculture. According to him productivity of agriculture is based on the HYV seeds, chemical fertilizers, scientific water management and other practices. These are suitable components of the progress and modernization of Indian agriculture. Pal (1975), in his study has found out that agriculture being the prominent sector of economy, the pace of economic development of the country, has been still continues to be significantly influenced by the pace of its agricultural development. In fact, several eminent scholars have explained the spatio-temporal variations in agricultural development. (Mellor, 1967; Mitra, 1967; Nath, 1969; Sharma, 1971; Alam, 1974; Shenoi, 1975; Mohammad Ali, 1979; Srivastava, 1983). Swaminathan (2009) expressed that agriculture is not just a food providing machine but the backbone of the livelihood of sixty per cent of people of India. According to Datt and Sundharam (2009), agricultural growth has a direct impact on poverty eradication, health, nutrition of rural masses, national security and multiplier effect on entire economy. Peter (1988) argued that the growth in agricultural productivity is central to development. Agriculture is the largest sector of the nation which provides about one-fourth GDP, gives livelihood to more than sixty per cent of population and employs nearly 69 per cent of the total workforce (Ranganathan, 2003). Thus, the development of agriculture sector can serve up as a catalyst for rapid growth of whole economy (Maity and Chatterjee, 2006). They all have tried to understand the pattern and processes of the crucial problem of agricultural development as it is a multidimensional concept. There are concerns regarding the agriculture sector in India as the compound growth rate of total food grains were less than two percent in the last decade i.e. area: 0.29, production: 1.96, yield: 2.94 (Ministry of Finance, 2011); making traditional farming a non viable agricultural activity. Disparities in productivity across regions/districts and even within crops persist with significant increase in small and marginal farm holdings. Agricultural development denotes the quality of agricultural system of a region; it is a multi dimensional concept which mainly includes development in a real strength of cropped land, improvement in farm practices/system, improved farm implements, irrigation system and irrigated area, high yielding improved varieties of seeds, chemical fertilizers, insecticides and pesticides, intensity of cropping and specialization and commercialization of agriculture (Mohammed, 1980).The changing agro-economic scenario drew attention of research workers on diffusion of technological development in agriculture. In India majority of its population depend upon agriculture. So a vast rural mass tries to earn their livelihood from agricultural land. With fast increasing pressure of population on agricultural land, old methods and techniques of production cannot cope with

growing demand. As a result, new technologies and commercial crops are adopted to develop agro-economy. For these reason emphases on the diffusion of agricultural innovation are stressed. Therefore, an attempt has been made to identify the spatio-temporal pattern of agricultural development in six development blocks of Dehradun district.

## Database and Methodology

Agricultural development is unquestionable a multidimensional concept of which crop productivity is one of the vital aspects. Crop productivity is to be judged not merely from quantity of production but also from the variety and quantity of the produce. The simplest and crudest measure of crop productivity is the yield per hectare of various crops. A desirable sophistication is introduced by finding out the value of crop produce per hectare of net area sown/cropped area or per cultivator/ agricultural worker. Produce per hectare of net area sown or cropped area is an expression of the output per unit of agricultural land, and produce per agricultural worker or cultivator reflects the economic level of agricultural population. Sometimes it is standardised by computing net output (gross output minus cost of inputs) per hectare of net area sown. This computation involves several methodological problems and is generally given up in favour of a more convenient indicator of output per hectare of agricultural land or per worker.

Commercialization of agriculture is another dimension of agricultural development. The percentage of cropped area under cash crops may be used as a measure of commercialization of agriculture. The density of market centres per 1000 sq.km of area can also provide a clue to the degree of commercial agriculture. The development of agriculture is to be judged also from the degree of equity in farm incomes and nature of agrarian relation. Above all agricultural development should not produce deterioration in ecological condition. It should not lead to defacement of forests, exhaustion of soil nutrients, depletion of underground water and emergence of water logging condition. Conservation of physical resources is an integral part of any agricultural development (Krishan, 1992).The spatial pattern of agricultural development has been measured in terms of technological factors such as chemical fertilizers (NPK), irrigation, HYV of seeds and implements.

The following eight indicators were selected for measuring the agricultural development.

**Table-1.**List of Selected Variables

| S.No | Variables | Definition |
|---|---|---|
| 1 | X1 | 1. Cropping Intensity. |
| 2 | X2 | 2. Percentage area under food-grain to gross cropped area. |
| 3 | X3 | 3. Irrigation Intensity. |
| 4 | X4 | 4. Percentage of canal irrigation to net irrigated area. |
| 5 | X5 | 5. Percentage of fertilizer consumption /hectare of gross area (in kg). |
| | | 6. Percentage of agricultural workers to the total main workers. |
| 6 | X6 | 7. Rural literacy rate. |
| 7 | X7 | 8. Per capita production of food-grain in kg. |
| 8 | X8 | |

The present study is based on secondary source of published data for the years 1981, 1991 and 2001obtained from the statistical magazine of Dehradun district.

For measuring the relative score of various attributes of agricultural development in Aligarh district. Standard score technique has been applied (Z-Score).

Where

Zi= Standard score for the $i^{th}$ observation $Z_i = \frac{X_i - \overline{X}}{S.D.}$

Xi= Original value of the observation

$\overline{X}$= Mean for all the values of X

S.D=Standard Deviation of X

Further, the results of the standard score obtained for different indicators were aggregated in order to find out the composite index or composite standard score (CSS) so that the regional differences in the levels of development of various blocks may be obtained on a uniform scale.

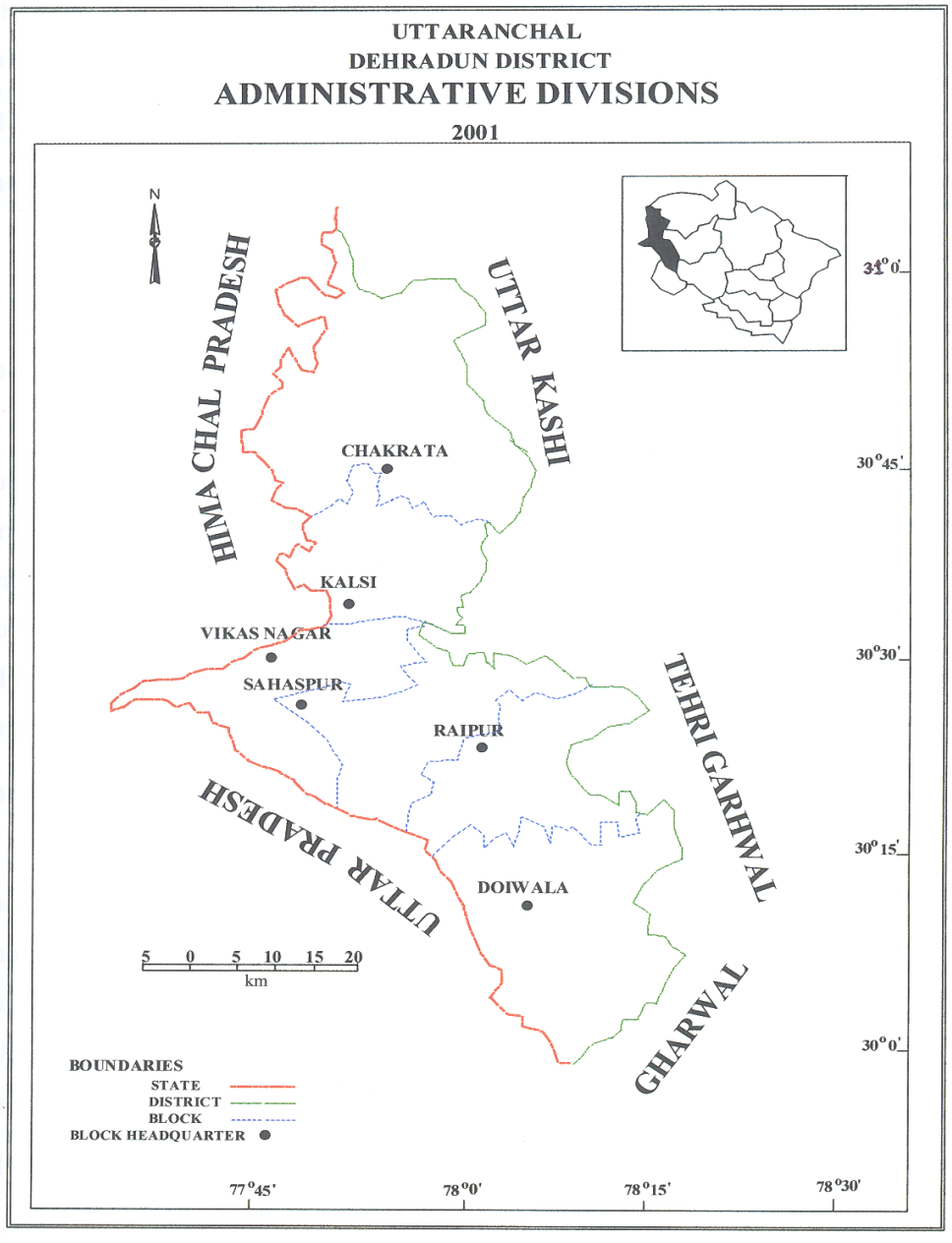
All the data have been arranged in descending order of composite standard score. The positive values relating to the blocks score how high level of agricultural development and negative value the low level of development.

In order to classify the blocks according to the magnitude of development, the composite scores are divided into three classes viz; high, medium and low.

## Study Area

Dehradun district is situated in the foothills of Himalayas and is facing severe environmental degradation due to various reasons, namely, improper land use patterns, deforestation activities and uncontrolled urban sprawl, industrial and mining activities and population growth. The district lies between 29°58'00" N and 31°02'30" N latitudes and 77°34'05" E and 78°18'13" E longitudes (Fig.1), covering an area of 3088 SqKm. The total population, as per 2011 census, is 1.7 million the second highest in Uttarakhand after Haridwar. Out of the total population 55.90 per cent lives in urban regions of the district while 44.10 per cent lives in the rural areas. The district is divided into six community development blocks consisting of 764 villages. These blocks are Chakrata, Kalsi, Vikasnagar, Sahaspur, Raipur and Doiwala having 153, 204, 61, 120, 129 and 76 villages respectively. The decadal growth rate has jumped up from 25 per cent (1991-2001) to 32.48 per cent (2001-2011). The district has a gender ratio of 902 as against a state average of 963. The population density is 550 while the state's average is 189. The literacy rate is the highest in the state at 85.24 per cent (90.32 for males and 79.61 for females).

**Fig-1.**




Source : Regional Office, Census of India, Dehradun District, Uttaranchal

## Spatial Pattern

Agricultural development is a multidimensional process. It is a key element of rural development. There is a legitimate aspiration of the people in rural areas to improve their standard of living and to share the fruits of development. The primary objective of agricultural development is usually to increase the growth of agricultural output. It is a requisite of an economic growth.

Nevertheless, the utilization of agricultural potential and the levels of development attained vary from block to block (on the basis of composite mean z-score of the eight indicators).

## Spatial Distributional Pattern of Agricultural Development (1981)

### (i) High Levels of Agricultural Development (Above +0.21)

This category consists of three blocks, viz. Kalsi (0.37), Sahaspur (0.40) and Vikas Nagar (0.21). These blocks form a continuous belt in the central part of the district as shown in fig. 2. The blocks recording high level of agricultural development have attained their status due to a variety of reasons. The farmers living central portion enjoy better cropping intensity, irrigation facilities, use of chemical fertilizer, production of commercial crops, more agricultural workers and other agricultural technology and infrastructural facilities.

### (ii) Medium Level of Agricultural Development (+0.21 to –0.21)

The medium level category comprises of only one block i.e. Raipur (-0.19) which is located in the south-central part of the district. The use of chemical fertilizer, rural literacy rate and canal irrigation facilities having positive values while the other indicators shows negative values of z-score in this block. So agricultural development is of moderate type in this part of the study area.

### (iii) Low Level of Agricultural Development (below –0.21)

Only two blocks come under this category: they are, Chakrata (-0.20) and Diowala (-0.59). Both the blocks are located in the extreme positions, Chakrata block is located in the northern most part and Diowala in the extreme south portion of the district. In these blocks most of the indicators show negative z-score as shown in table 3. Because of their negative values these blocks come under the low category of agricultural development.

## Spatial Distributional Pattern of Agricultural Development (1991)

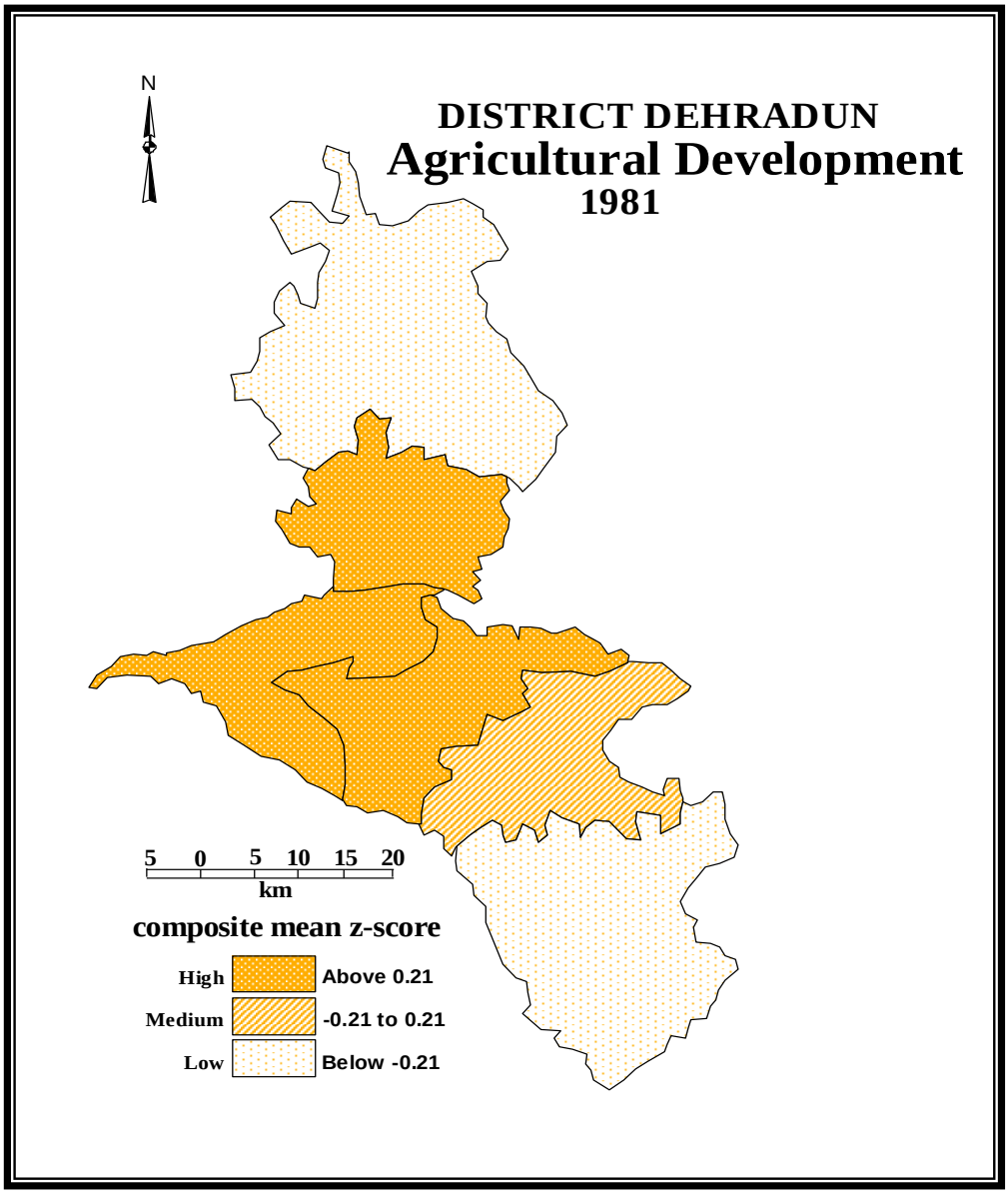
### (i) High Level of Agricultural Development (Above +0.13)

In 1991 this category consists of only one block i.e. Vikas Nagar (0.42) which is located in the western part of the district while in 1981, three blocks were come under this high category.

### (ii) Medium Level of Agricultural Development (+0.13 to –0.13)

Three blocks of the district lie in this medium category. Two of them lie in the central part, they are, Sahaspur (0.08) and Raipur block (-0.13) and one lie in the upper central part of the district i.e. Kalsi block (0.11) as shown in fig. 3. In 1981 Kalsi and Sahaspur were under the high level of agricultural development but in 1991 these blocks were lacking in cropping intensity and irrigation intensity which results in decreasing the production of food-grains (Table 3).

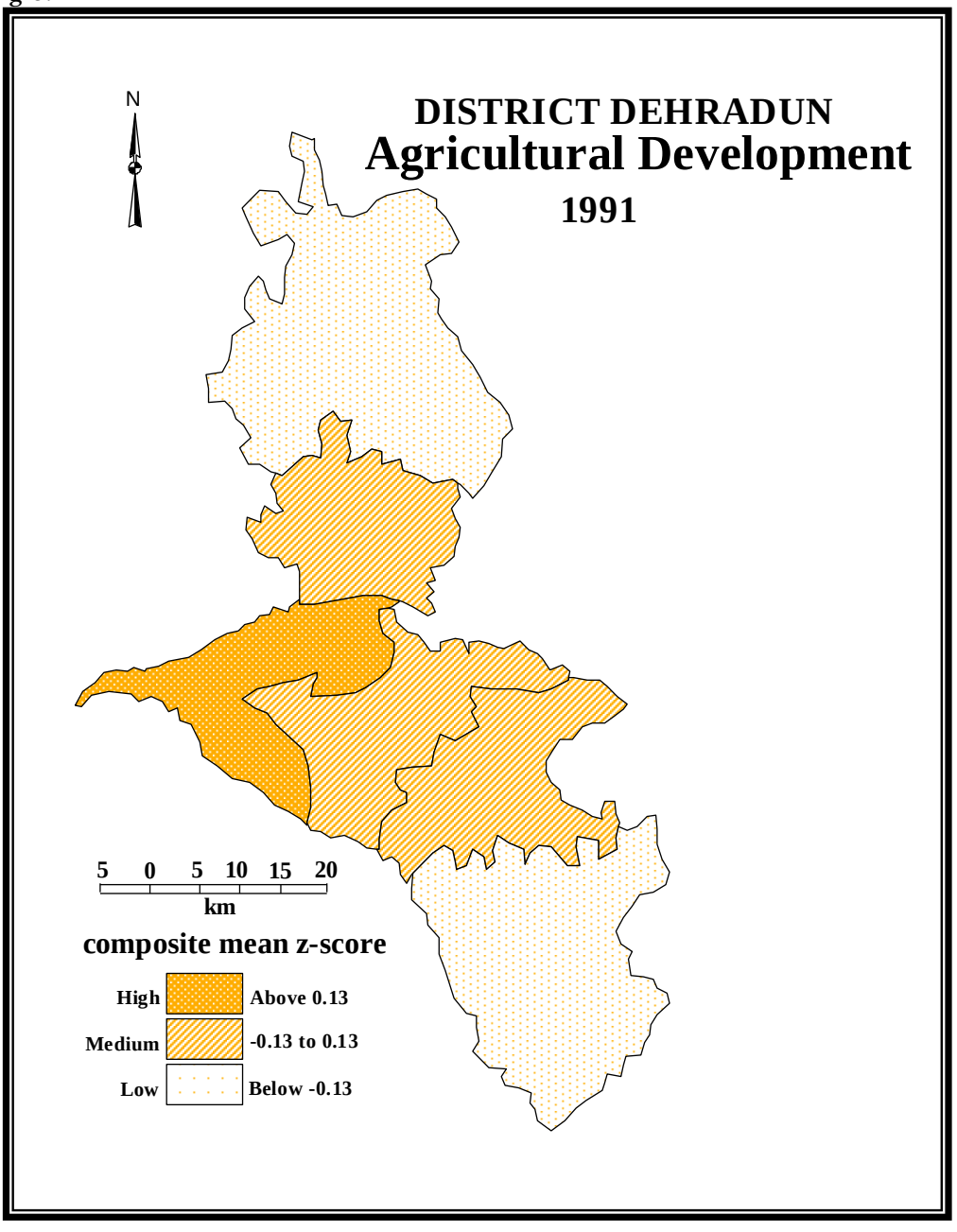
**Fig-2.**




### (iii) Low Level of Agricultural Development (below –0.13)

Two blocks come under this low category of agricultural development in 1991 as observed in 1981. They are Chakrata (-0.23) and Doiwala blocks (-0.25). The composite score of these blocks is more or less same as shown in Table 3. Both the blocks are located in the extreme portions of the district; one in northern most part, while other in southern most part of the district (Fig. 3). The reason for the low development of agriculture in these blocks was that Chakrata block located on a hilly region while in Doiwala block most of the area is covered by reserved or protected forest.

**Fig-3.**




**Spatial Distributional Pattern of Agricultural Development (2001)**

### (i) High Level of Agricultural Development (Above +0.22)

In 2001 two blocks lie in this category namely, Kalsi (0.56) and Vikas Nagar (0.40) which form a prominent area in the west central part of the district. Vikas Nagar attained the high level of agricultural development in all the three decades. While Kalsi block enjoys high level of agricultural development in 1981 and 2001 while it was in the medium grade in 1991.

### (ii) Medium Level of Agricultural Development (+0.22 to –0.22)

Two blocks come under this medium category namely, Sahaspur block (-0.16) and Doiwala (-0.07) while in 1981 Sahaspur block was under the high grade (0.45), and in 1991 it came under the medium grade (0.08). This block shows a decrease in agricultural development (Table 3 whereas Doiwala block is concerned; this block was under the low grade in both the years of 1981 and 1991 but in 2001 it is under the medium grade. It shows an increase in agricultural development (Fig. 4).

### (iii) Low Level of Agricultural Development (below –0.22)

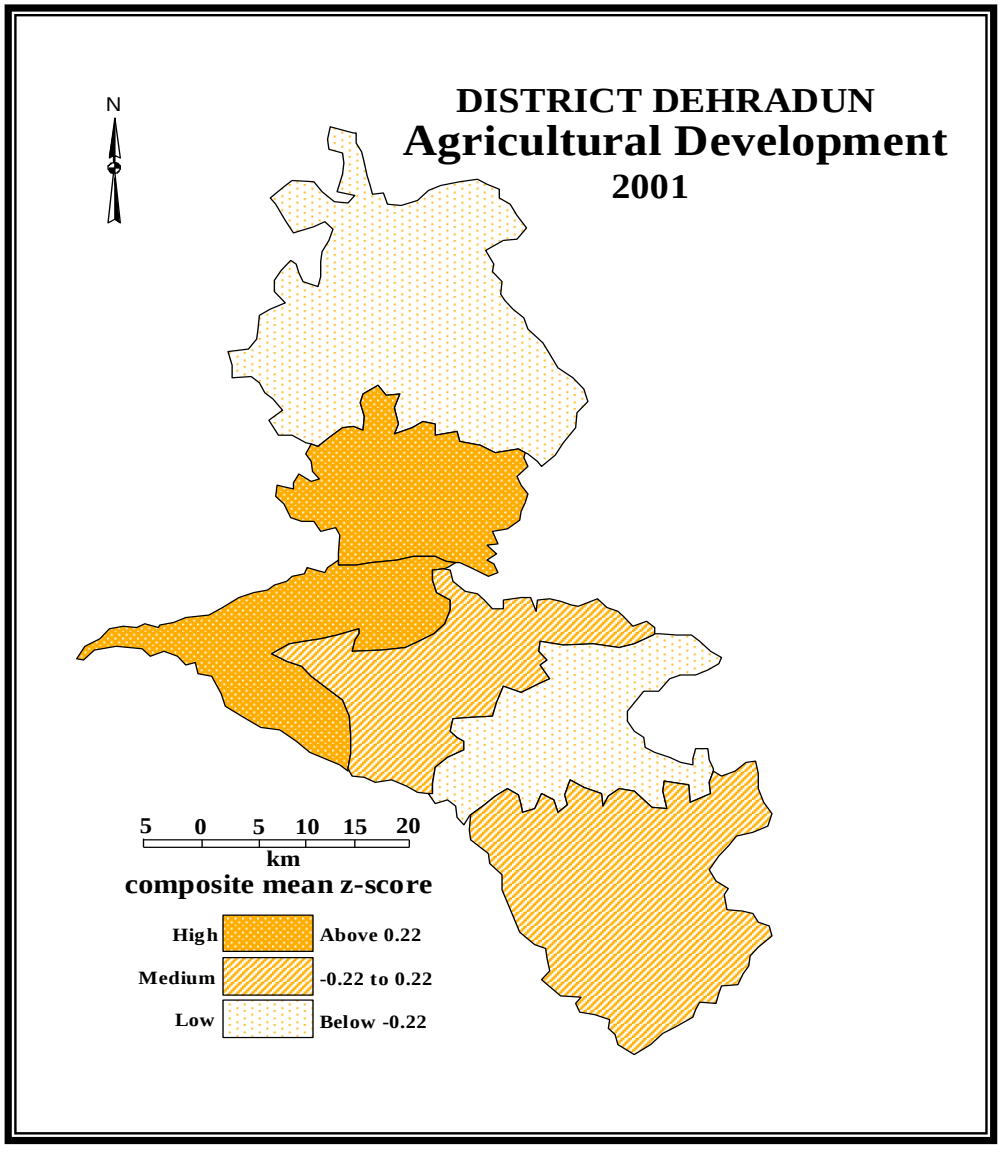
Two blocks come under this low category viz, Chakrata (-0.27) and Raipur (-0.46) (Table 3). Previously Raipur block was under the medium grade in 1981 and 1991 respectively but in 2001 the agricultural development decreased. Factors like urbanization and industrialization affect the agricultural development of this block.

Thus it is observed that even after twenty years there is a little change in the spatial pattern of blocks having high level of development which form a cluster in the upper central portion, medium level also covers the central portion belt in 2001, it also covers the southernmost part of the district. While the blocks with low level of development are found in the northern most part and southern most part except in 2001.

## CONCLUSION

It has been concluded through the study that high level of agricultural development is found in the upper central part of the study area. This portion attained this status due to a variety of reasons. The farmers living in this portion enjoy better irrigation facilities; cropping intensity is high with plenty of agricultural workers coupled with more production of food grains. The medium level of agricultural development is found in the lower central part of the study area. In 1981 and 1991 Raipur block was in the medium grade but in 2001 it came in low grade because in 2000 Dehradun district become the capital of Uttarakhand state so more and more non-agricultural development has taken place. Chakrata block shows low level of agricultural development in all the three decades because of its topographic and climatic conditions.

**Fig-4.**

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Contributors/Acknowledgement: All authors contributed equally to the conception and design of the study.

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**Table-2.** Agricultural Development in Dehradun District

| Blocks | | Cropping intensity | % area under food-grains to GCA | Irrigation intensity | % of canal irrigation to NIA | Consumption of NPK in (kg)/ hec of GCA | % of agri. Workers to total main worker | Rural literacy rate | Per capita production of food-grain in kg |
|---|---|---|---|---|---|---|---|---|---|
| Chakrata | 1981 | 147.60 | 79.20 | 167.00 | 2.90 | 5.60 | 87.89 | 16.00 | 323.00 |
| | 1991 | 145.71 | 78.69 | 189.31 | 11.55 | 5.86 | 81.05 | 27.38 | 287.11 |
| | 2001 | 154.22 | 70.41 | 159.09 | 03.45 | 10.37 | 76.41 | 47.99 | 240.47 |
| Kalsi | 1981 | 182.10 | 84.80 | 156.40 | 74.10 | 7.40 | 85.54 | 24.50 | 290.00 |
| | 1991 | 155.13 | 81.91 | 178.89 | 41.47 | 7.29 | 79.55 | 38.05 | 283.50 |
| | 2001 | 174.25 | 85.11 | 181.75 | 29.60 | 18.36 | 82.27 | 57.55 | 295.05 |
| Vikas Nagar | 1981 | 162.40 | 76.70 | 175.40 | 83.50 | 31.20 | 56.80 | 34.40 | 237.00 |
| | 1991 | 192.01 | 74.87 | 190.20 | 64.74 | 56.24 | 59.41 | 46.08 | 181.54 |
| | 2001 | 171.29 | 71.93 | 169.64 | 82.10 | 64.39 | 36.49 | 65.08 | 152.00 |
| Sahaspur | 1981 | 175.30 | 81.00 | 208.30 | 52.80 | 26.40 | 40.24 | 43.20 | 267.00 |
| | 1991 | 172.55 | 75.66 | 187.45 | 39.71 | 47.65 | 37.28 | 62.38 | 143.81 |
| | 2001 | 134.87 | 75.83 | 129.57 | 36.22 | 62.24 | 24.32 | 75.19 | 134.44 |
| Raipur | 1981 | 147.50 | 71.60 | 155.80 | 81.90 | 44.70 | 8.93 | 49.60 | 160.00 |
| | 1991 | 160.49 | 72.85 | 171.66 | 66.93 | 73.30 | 7.82 | 71.20 | 26.02 |
| | 2001 | 120.59 | 65.70 | 128.89 | 64.30 | 69.83 | 4.43 | 78.20 | 19.96 |
| Doiwala | 1981 | 129.00 | 65.40 | 112.30 | 34.10 | 82.80 | 25.62 | 49.90 | 138.00 |
| | 1991 | 185.88 | 68.87 | 139.37 | 35.74 | 74.61 | 36.23 | 70.46 | 103.71 |
| | 2001 | 143.72 | 66.28 | 143.16 | 61.02 | 80.57 | 16.94 | 79.19 | 70.48 |
| District | 1981 | 155.30 | 76.70 | 152.40 | 55.30 | 32.90 | 34.19 | 36.30 | 223.00 |
| | 1991 | 170.69 | 74.87 | 167.93 | 46.94 | 47.77 | 31.93 | 57.57 | 101.26 |
| | 2001 | 148.27 | 72.36 | 145.58 | 58.07 | 56.41 | 21.81 | 70.50 | 81.38 |

**Source:** Statistical Magazine of Dehradun District,1981, 1991and 2001.

**Table-3.**Agricultural Development on the basis of composite mean z-score

| Blocks | | Cropping Intensity | %area under food-grains to GCA | Irrigation intensity | % of canal irrigation to NIA | Consumption of fertilizer in kg/hec on GCA | % of agri. Workers to total main workers | Rural literacy rate | Per capita production of food-grain in kg. | Composite index |
|---|---|---|---|---|---|---|---|---|---|---|
| Chakrata | 1981 | -0.49 | 0.43 | 0.14 | -1.63 | -0.96 | 1.16 | -1.46 | 1.19 | -0.20 |
| | 1991 | -1.27 | 0.71 | 0.68 | -1.55 | -1.24 | 1.08 | -1.39 | 1.13 | -0.23 |
| | 2001 | 0.21 | -0.30 | 0.33 | -1.50 | -1.39 | 1.13 | -1.52 | 0.86 | -0.27 |
| Kalsi | 1981 | 1.25 | 1.24 | -0.20 | 0.60 | -0.90 | 1.09 | -0.85 | 0.74 | 0.37 |
| | 1991 | -0.75 | 1.42 | 0.14 | -0.09 | -1.19 | 1.03 | -0.80 | 1.10 | 0.11 |
| | 2001 | 1.17 | 1.74 | 1.37 | -0.58 | -11.2 | 1.31 | -0.77 | 1.39 | 0.56 |
| Vikas Nagar | 1981 | 0.26 | 0.06 | 0.41 | 0.90 | -0.06 | 0.19 | -0.14 | 0.02 | 0.21 |
| | 1991 | 1.29 | -0.13 | 0.72 | 1.04 | 0.39 | 0.32 | -0.36 | 0.10 | 0.42 |
| | 2001 | 1.03 | -0.08 | 0.81 | 1.27 | 0.46 | -0.11 | -0.17 | 0.00 | 0.40 |
| Sahaspur | 1981 | 0.91 | 0.54 | 1.46 | -0.07 | -0.23 | -0.33 | 0.50 | 0.43 | 0.40 |
| | 1991 | 0.22 | 0.04 | 0.58 | -0.18 | 0.11 | -0.45 | 0.54 | -0.26 | 0.08 |
| | 2001 | -0.71 | 0.46 | -1.03 | -0.35 | 0.39 | -0.49 | 0.63 | -0.17 | -0.16 |
| Raipur | 1981 | -0.50 | -0.68 | -0.22 | 0.85 | 0.41 | -1.31 | 0.96 | -1.04 | -0.19 |
| | 1991 | -0.45 | -0.58 | -0.23 | 1.15 | 0.94 | -1.49 | 1.02 | -1.41 | -0.13 |
| | 2001 | -1.40 | -0.95 | -1.06 | 0.64 | 0.65 | -1.11 | 0.87 | -1.29 | -0.46 |
| Doiwala | 1981 | -1.43 | -1.59 | -1.61 | -0.65 | 1.75 | -0.79 | 0.98 | -1.34 | -0.59 |
| | 1991 | 0.95 | -1.46 | -1.90 | -0.37 | 0.99 | -0.49 | 0.98 | -0.66 | -0.25 |
| | 2001 | -0.29 | -0.87 | -0.41 | 0.52 | 1.02 | -0.72 | 0.95 | -0.79 | -0.07 |

**Source:** calculated by the author